FSIS Food Safety Review

VOLUME 1 • NUMBER 1 • SUMMER 1991

FSIS Works with Food Safety Consortium

Agency Readies Irradiation Regulation

FOOD SAFETY & INSPECTION SERVICE UNITED STATES DEPARTMENT OF AGRICULTURE

Welcome to the first issue

Welcome to the first issue of the *FSIS Food Safety Review.* The Food Safety and Inspection Service has a long, proud history of protecting the public health. Our roots go back to 1906, when Upton Sinclair's book, "The Jungle," prompted President Theodore Roosevelt to order an investigation into conditions in meat plants. This led to Congress enacting much stricter controls on meat production.

We've come a long way since then. Today, FSIS has almost 10,000 employees who are responsible for the safety of the nation's meat and poultry supply, including products imported into this country. They are a dedicated workforce of veterinarians, food inspectors, and a host of other professionals, such as food technologists, microbiologists, and epidemiologists.

While reflecting on our roots and our accomplishments helps us to evaluate where we've been, our focus must be on the future. To regulate a modern industry, we must be a modern public health agency. To that end, our goal is to make our program as science-based as possible. This means our policies are established on the best scientific data available to us, not on the latest newspaper headlines.

Our employees are trained by experts in the fields of public health, food technology, veterinary medicine, and inspection practices. And, we encourage a sharing of information among government officials, industry representatives, health professionals, and the public so that we can best meet the needs of all concerned.

It is this last objective—a sharing of information—that has prompted us to initiate this magazine. We want to expand our successful program of communicating with the public and industry to include more information for our fellow professionals in public health, whether they be in government, academia, or the private sector.

At the Food Safety and Inspection Service, we intend our *Food Safety Review* to be a long-term, comprehensive medium of communication with those who share our goal of improving the health of all Americans.

Lester Crawford, DVM, PhD.
Administrator, FSIS

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FSIS Food Safety Review is published by USDA's Food Safety and Inspection Service, the agency charged with ensuring the safety, wholesomeness and proper labeling of the nation's meat and poultry supply. The purpose of the magazine is to inform food science and public health professionals of current science-based initiatives to protect the public health.

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FSIS Food Safety Review

VOLUME 7 NUMBER SUMMER 1991

FSIS Studies Detection of Food Safety Hazards

by Denise Clarke
HACCP Communications Team Director

Consumer demands for fresher, ready-to-eat-and-serve meals have prompted industry to develop a new generation of refrigerated food. But, while convenient and easy to prepare, these new refrigerated products could also produce potential food safety hazards due to mistakes in processing, distribution, retailing, handling or preparation by the consumer.

The potential for problems can arise when there is inadequate refrigeration or time/temperature abuse, failure of a backup preservation system, inadequate heat treatment, or recontamination after the product is cooked. Pathogens such as *Listeria monocytogenes* can exist and grow in refrigerated food products, which could cause foodborne illness, especially for immunocompromised individuals.

To address these concerns, the National Advisory Committee on Microbiological Criteria for Foods (NACMCF) and the Food Safety and Inspection Service (FSIS) are studying the safe production and inspection of refrigerated foods.

"It is necessary to identify the areas, or critical control points (CCPs), where food safety hazards can most likely be controlled, and to determine what actions should be taken to prevent such hazards," says Dr. Catherine Adams, FSIS assistant administrator. She is also a member of the NACMCF committee and chairs the Meat and Poultry Working Group.

In addition, Dr. Adams directs the study now underway by FSIS to determine the best way to implement the Hazard Analysis and Critical Control Point (HACCP) system in meat and poultry inspection.

Participants at the first HACCP workshop review the processes involved in making and inspecting refrigerated foods. They identified 14 CCPs for controlling food safety hazards.

HACCP is a simple, but very specific method for identifying hazards and implementing the appropriate control to prevent potential hazards. Designed to prevent, rather than detect food safety hazards, the HACCP system for food inspection is being studied by FSIS as a tool to identify and prevent food safety hazards during meat and poultry production.

Workshop Series Begins

"HACCP will bring a greater degree of scientific integrity and scrutiny to food production and inspection," says FSIS Administrator Dr. Lester M. Crawford.

In opening remarks at the first HACCP workshop session in February in Baltimore, Dr. Crawford challenged participants to recognize that the key to improving food safety is to move away from traditional, sometimes "police-like" inspection practices.

"We are aiming at an approach where prevention is the prevailing rule and industry recognizes its accountability for process control and food safety," said Dr. Crawford.

Soon after FSIS launched its study in early 1990 to determine the effectiveness of a HACCP system in meat and poultry inspection, the agency announced plans to develop generic HACCP plans for five products: refrigerated foods, cooked sausage, fresh ground beef, poultry (young chickens) slaughter, and swine (market hogs) slaughter.

Team Coordinates Study

FSIS selected a Special Team of five employees from field offices and one from headquarters in Washington, D.C.

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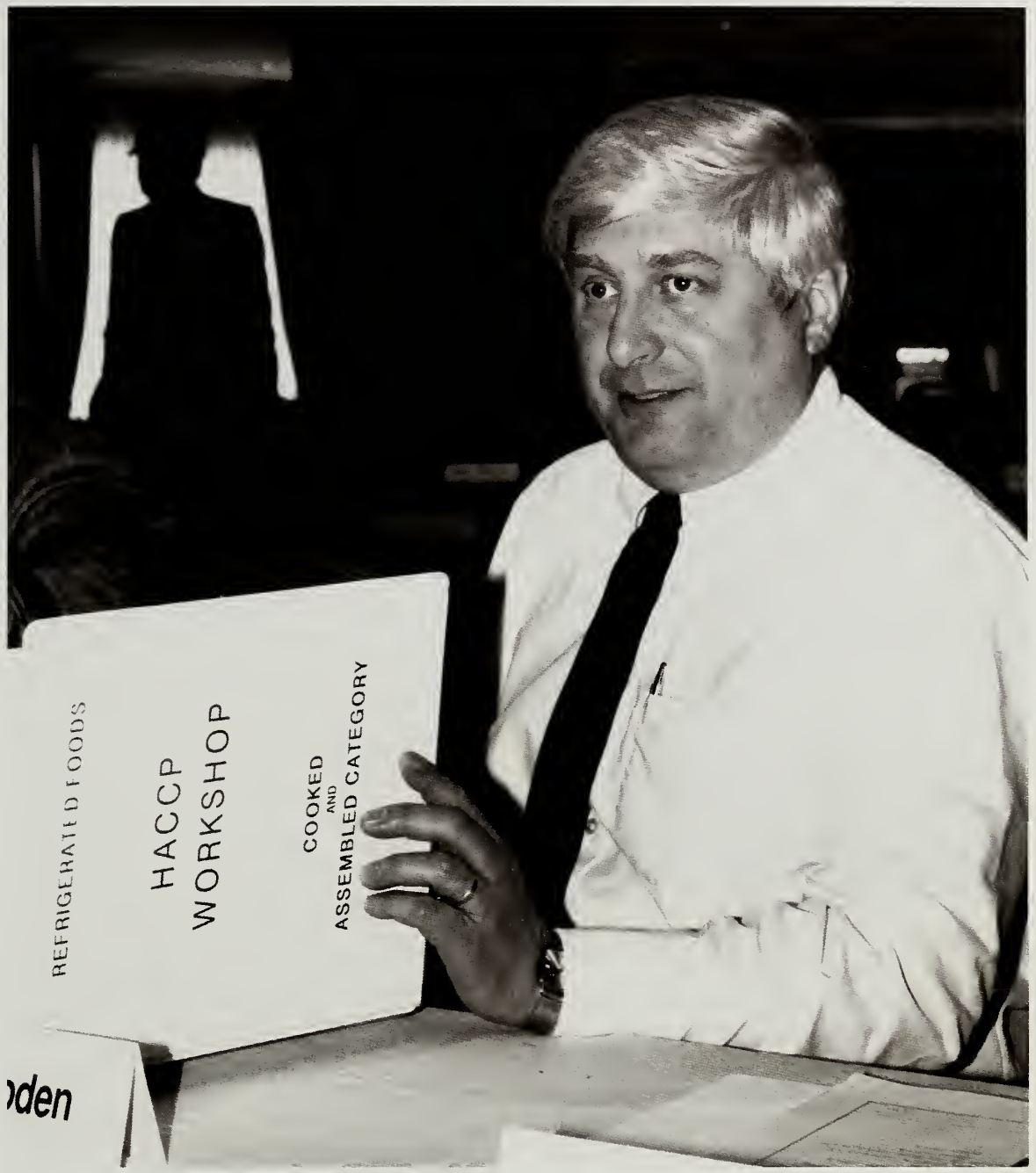
to organize workshops and plan for eventual in-plant testing. In addition, FSIS inspectors and veterinarians who work in processing plants and slaughter plants were named as subject matter experts (SMEs) to provide technical guidance for each workshop.

More than 40 industry representatives and 40 observers attended the first workshop in Baltimore, which focused on ready-to-eat refrigerated foods. For the purpose of the workshop, refrigerated foods were defined by the Special Team as, "refrigerated foods containing cooked, uncured meat and poultry products that are packaged for extended refrigerated shelf-life and that are ready-to-eat or prepared with little or no heat treatment."

FSIS further narrowed the workshop product to a cooked and assembled product. The industry group then decided on a hypothetical product: "cooked meat or poultry with a starch and vegetables in a seasoned sauce with garnish."

Industry participants in the workshop developed a preliminary generic HACCP plan for refrigerated foods that identified 14 CCPs. Control of the process at these CCPs will help prevent potential microbiological, physical and chemical hazards for both meat and nonmeat ingredients.

The CCPs included preparation, cooking, chilling before packaging, assembly of components, flushing with gas atmosphere, package inspection, labeling and code dating, chilling after packaging, and storage.



Robert Wooden, manager of product safety and regulatory affairs at the Pillsbury Co., helps develop a preliminary HACCP plan for refrigerated foods at the first HACCP workshop. A second HACCP workshop, held last spring, focused on cooked sausage. HACCP workshops on poultry slaughter, fresh ground beef, and swine slaughter are planned for later in 1991 and 1992.

Generic Model Developed

"The generic plan reflects the preventive measures necessary to produce a safe refrigerated food product," says Dr. Wallace Leary, HACCP Special Team director for FSIS. "The model was designed to be generic and to serve as the foundation to build upon. Individual plants should use the generic model as a guide to develop a plant-specific model for their operations."

The generic model also outlined the necessary steps to monitor, document and verify that the HACCP plan is working effectively.

"Although company representatives recognized that distribution, retail handling, and consumer handling are CCPs, the representatives did not include these three CCPs in the model because they are not part of the agency's regulatory authority," says Dr. Leary.

Workshop participants did not reach final consensus on whether the receiving step in the process flow chart should be considered a critical control point, particularly for sensitive ingredients. They suggested that vendor specification and certification letters might be required for sensitive ingredients.

The group deferred this issue to a five-member Industry Steering Committee selected at the meeting.

Volunteer Plants Sought

The next step in the HACCP Study will be to test and evaluate the HACCP model in three volunteer plants. The Special Team is conducting site visits at volunteer plants to determine if any changes are needed in the generic model. Should changes become necessary, the Special Team will discuss them with the Industry Steering Committee. The Committee will then refine the generic model, using recommendations from the Special Team.

According to Dr. Adams, the in-plant tests for the refrigerated foods, cooked sausage and poultry slaughter HACCP plans should be completed and evaluated by late 1992. FSIS will then evaluate the

effectiveness of the models and their implementation, and will submit its evaluation to a peer review panel.◆

HACCP Coordinator

Dr. Catherine Adams, the Assistant Administrator for the Food Safety and Inspection Services, advises the Office of the Secretary of Agriculture on scientific aspects of important safety issues, including agricultural chemical use and microbiological contamination.

Dr. Adams received her doctoral degree in Food Science from the University of Illinois. She also received degrees in food science and human nutrition from Michigan State University and from Pennsylvania State University. She serves as the United States' Delegate for the Codex Committee for Food Hygiene and is chairperson of the Meat and Poultry Working Group and co-chair of the Listeria Monocytogenes *Working Group of the National Advisory Committee for Microbiological Criteria for Foods.*

Peers Revise, Endorse HACCP Evaluation Plan

Six peer reviewers who were selected to review the Food Safety and Inspection Service's draft evaluation plan for food inspection procedures based on the Hazard Analysis and Critical Control Point (HACCP) system recommended several modifications to the evaluation criteria. They met in early March.

The group endorsed the goals of the FSIS plan to evaluate the HACCP Study, including the implementation of HACCP in volunteer plants, the potential national implementation of HACCP in meat and poultry inspection, and the overall HACCP Study.

The peers are experts in meat and poultry sciences, public health, epidemiology, statistics, and quality management programs. They are Lt. Col. Dale Boyle, DVM, U.S. Army; Dr. Eugene Gangarosa, Emory School of Public Health; Charles Kendig, Xerox Corporation; Dr. James Marsden, American Meat Institute; Laszlo Papay, IBM Corporation; and Dr. David Theno, Theno & Associates.

The Evaluation Plan outlined six tasks subject to peer review: HACCP Model Checklist, National Profiles, Quantitative Plant Data, Qualitative Plant Data, Literature Review, and Inspector and Plant Personnel Survey. The HACCP evaluation will collect both quantitative and qualitative data. The agency will obtain on-line and finished product data for microbiological, chemical and physical factors.

Microbiological criteria for evaluation primarily focus on indicator microorganisms, including aerobic plate count, coliforms and *Listeria* species; chemical factors such as pH and chlorine concentration in water; and physical factors such as product temperature and package integrity.

The peers made the following recommendations, which FSIS has adopted:

- A specially trained FSIS employee to collect the test data at each volunteer plant. This will help ensure consistency and uniformity in the data collection procedures;
- The data collection should have three phases:
  Phase I: Three months of baseline data collection.
  Phase II: Implementation Phase: The plant will begin implementing the HACCP plan. The peers recommended a minimum of three months to get the plan underway. Data will be collected during this period and shared with the test plant. Training of plant and FSIS personnel will be accomplished during Phase II. Both FSIS and the plant must agree when the plant is ready to begin Phase III.
  Phase III: Operational Evaluation, six months of data collection during the operation of the HACCP plan in the volunteer plant.
- The peers recommended that FSIS share with plant personnel the data collected during Phases I and II.
- The peers agreed that microbiological data collection should be focused on indicator organisms, such as *E. coli* and *Staphylococcus aureus*. However, the peers recommended collecting salmonellae incidence and enumeration data for the poultry slaughter, swine slaughter and fresh ground beef tests.
- The peers suggested FSIS provide encouragement, as well as generic HACCP plans, technical papers and other HACCP materials to plants that might volunteer to be test plants but are not selected.
- The peers recommended that all data collected by FSIS during the HACCP Study should be confidential. ◆

Campylobacteriosis
Control and Prevention

by Don A. Franco,
DVM, MPH, Dipl. ACVPM

SUMMARY

Campylobacteriosis is an important infectious disease throughout the world. It is now recognized as one of the most frequent causes of bacterial diarrhea. New knowledge of Campylobacter jejuni *as a human pathogen and of its wide distribution in animal reservoirs has brought about significant advances in our knowledge of the epidemiologic characteristics of the infection. The vehicles incriminated as sources of infection are widespread. In the early 1980s, 2,000-3,000 people became ill from unchlorinated water in Vermont. Most outbreaks have been associated with unpastuerized milk and unchlorinated water. Dairy products and poultry have also been implicated in illnesses that have occurred sporadically without a finite determination as to the mode of transmission. Factors that perpetuate the condition are unhygienic food handling and storage practices, environmental contamination from animal wastes and other sources, spreading the organism during animal slaughtering and processing, and concentrating animals in brooding houses and feedlots. Drinking raw milk or unchlorinated water are also risk factors. Close national and international cooperative efforts will be essential to reduce or eliminate the risk from this foodborne pathogen. A four-page pamphlet with further information about the source and control of* Campylobacter *is available from FSIS. Write: FSIS Information Office, 1160-South Building, Washington, D.C. 20250.*

Campylobacter first was recognized about 80 years ago during a survey of epizootic abortion in ewes (28). The bacterium, observed by McFadyean and Stockman, resembled a vibrion that was often isolated from aborted fetuses (9).

Veterinary researchers since have found like bacteria associated with abortion and enzootic sterility in cows, winter dysentery in calves and diarrhea in swine (36,19,13). These early research workers called the organism *Vibrio jejuni* (36).

In 1946, Levy (25) reported a milkborne outbreak of acute diarrhea in man and described organisms resembling *Vibrio jejuni* in blood cultures from several patients. Human strains, however, were not extensively studied until 1957, when King, working with isolates from

human blood cultures, distinguished two groups of organisms.

One group corresponded closely to the existing description of V. fetus; the second group of organisms King called "related vibrios" (22).

In 1963, Sebald and Veron found that the two groups described by King differed in their DNA base-pair ratio (G & C mol %) from that of the other vibrios and proposed that these species be removed from the genus Vibrio and that they be called *Campylobacter* or "curved rod" (34,41).

In 1972, a Belgian research team applied veterinary isolation techniques to human cultures and provided the initial conclusive association of the enteric pathogenicity of *Campylobacter* (12). These researchers isolated *Campylobacter jejuni* from five percent of children with diarrhea (11). Their findings later were confirmed by Skirrow (32), and similar results have since been reported.

In some laboratories Campylobacter isolations outnumbered those of Salmonella and Shigiella together (6,2 1).

Since the initial isolation of *Campylobacter jejuni* from human diarrhea stools, the organism has become recognized as a leading cause of gastroenteritis (37). The zoonotic potential of this "new" enteric pathogen has been highlighted in numerous studies. The foods of animal origin most often implicated are poultry, meat and unpasteurized milk, in that order of significance (29). Outbreaks have been traced to raw milk and unheated water, while poultry has been a main vehicle in reported cases.

The Disease

Campylobacter is commonly found as commensals of the gastrointestinal tract of wild or domesticated cattle, sheep, swine, goats, dogs, cats, rodents, and all classes of poultry. Extensive reports in the scientific literature have demonstrated the role of animals or animal products as sources of human infection. They also note that many *Campylobacter* serotypes isolated from animals have caused disease in humans (7).

Symptoms and signs of *C. jejuni* infection lack special distinctive features and cannot be differentiated from illnesses caused by other enteric pathogens. Acute enteritis is the most common manifestation of the infection; symptoms persist from one day to one week or longer.

A prodromal phase, with fever, headache, myalgia, and malaise, occurs for 12 to 24 hours usually, but may last up to 48 hours before the onset of intestinal symptoms.

The most common symptoms of *Campylobacter* infection are diarrhea, malaise, fever, and abdominal pain. The diarrheic pattern can vary from loose stools to profuse, bloody, slimy and/or foul-smelling stools (8,27). In some patients, abdominal pain may be cramping, typically periumbilical, and the predominant sign of illness (8).

Vomiting may occur, but is rarely a marked feature. The illness is frequently self-limited within one to four days, and usually lasts no more than 10 days, occasionally relapsing (5).

Twenty-five percent of patients tend to have a recurrence of symptoms, often characterized by abdominal pain, and varying from a relatively mild gastroenteritis to an enterocolitis with bloody diarrhea and accompanying abdominal pain lasting for several weeks (27).

As with other intestinal pathogens, the clinical picture of *C. jejuni* infection varies from symptomless excretion to severe disease.

The Organism

Campylobacter is derived from the Greek word "Campily," meaning curved, and "bacter," meaning rod. *Campylobacter* fetus subspecies jejuni and C. fetus subspecies intestinalis are the principal human pathogens.

Campylobacter fetus subspecies jejuni, by far the more common organism, is an enteric pathogen and typically affects previously healthy persons (24). It has now been shown by DNA homology studies to actually represent two organisms, *C. jejuni and C. coli*. Most clinical laboratories do not separate the two organisms, even though invasiveness and antimicrobial susceptibility variables may exist (4).

All campylobacters grow at 37°C; however, *C. jejuni* grows best at 42 to 45° C and in an atmosphere containing 5-10 percent oxygen and is thus considered microaerophilic (20). The organism grows poorly, if at all, below 39°C or above 47°C. It favors a roughly neutral pH (6.5-7.5) although it has been shown to grow at a pH as high as 8.0 and as low as 4.8 (45).

Mode of Transmission

Infected animals excrete the organisms, thereby contaminating the environment and perpetuating the cycles of infection. The transmission to man may be by direct contact with infected animals or contaminated animal carcasses, or through the ingestion of contaminated food of animal origin or through unchlorinated water.

The foods of animal origin most often implicated are poultry products, unpasteurized milk, meat and eggs, and uncooked foods subjected to possible cross-contamination by meat and poultry products or with untreated sewage (15).

In 1984, Harris et al. reported a case control study in Seattle (King County), Wash., in which almost 50 percent of poultry from the processing plant surveyed was contaminated with *C. jejuni.* The highest contamination rate occurred during the period July through October. Poultry products from retail outlets in the same study had 22.3 percent positive cultures for *C. jejuni* (31).

Several other studies have implicated the spread of *C. jejuni* during the slaughtering process, and the inverse relationship between the degree of intestinal carriage and contamination. Regardless of the type of slaughtering, heavily infected flocks may result in a contamination rate of 100 percent for finished products.

The organism has also been isolated from diverse areas of the processing environs—chilling tanks, pickers, scald water, and fecal samples from incoming birds

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Editor's Note: *The text is based on a previously published article by the author in the* Journal of Environmental Health, *Volume 52, Number 2, September/ October 1989.*

Agency Readies Irradiation Regulation

by Lester M. Crawford,
Administrator, FSIS
and Susan G. Rehe,
FSIS Science Writer

Editor's Note: An account of a Hazard Analysis and Critical Control Point (HACCP) plan for food irradiation will appear in the next issue of FSIS Food Safety Review.

For several years, the USDA Food Safety and Inspection Service (FSIS) has been carefully studying the possible use of ionizing radiation in meat and poultry processing. Because it can effectively reduce the incidence of pathogenic microorganisms and parasites, irradiation is an appealing technology. However, FSIS has a regulatory mission to ensure that irradiation results in products that are safe, wholesome, and accurately labeled.

Although ionizing radiation has a long history of successful industrial applications, such as the sterilization of disposable medical supplies, the application of this technology to foods is a new challenge. It will be successful only if it is accepted as safe and useful by regulators, industry, and the general public.

International agreement on appropriate control and inspection procedures, careful development of Federal regulations, research sponsored by industry, and consumer education are all important parts of the process.

Regulation

In order to use irradiation in the processing of a particular food, the processor must petition FDA for approval, unless approval to irradiate that food has been granted previously.

If it is a meat or poultry product, the processor must then meet FSIS requirements. Meat and poultry products are considered adulterated if subjected to unapproved sources of ionizing radiation.

Although, in 1986, FSIS approved the use of irradiation of fresh or previously frozen pork to control trichina, no irradiated meat or poultry products are currently marketed in the United States.

However, on May 1, 1990, the FDA approved the use of irradiation on packaged, fresh or frozen uncooked poultry to control some foodborne pathogens, such as Salmonella. Campylobacter, and Yersinia (FDA, 1990). The FDA approval was granted in response to a petition filed by USDA in November 1986.

USDA must now define the requirements that will guide the practical implementation of this technology in poultry production. FSIS will set these requirements through notice and comment rulemaking.

Irradiated poultry will be available in the United States only after the regulatory process is completed. Even then, the market demand for this product will determine the extent to which the technology is used.

The U.S. Government does not believe its role is to advocate food irradiation over other technologies (Engel and Derr, 1988). We do view it as a viable method for ensuring a safe and wholesome food supply, and want to ensure that food processors have access to it.

We are developing our irradiation guidelines with international standards in mind.

Under the Federal Meat Inspection Act and the Poultry Products Inspection Act, foreign countries that export meat and poultry to the United States must establish and maintain inspection standards and requirements that are "at least equal to" those of the United States (Engel, 1989).

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(16, 44). When brought into the kitchen, contaminated raw products may cross-contaminate utensils, working surfaces and cloths, establishing a contaminated environment in areas where food is prepared.

Campylobacter spp. also may be spread by contaminated water not meant for drinking, or by contamination of a community water system or surface water by domestic and/or wild mammals and birds (42,38).

Campylobacter infection occurs frequently in dogs and cats, which can act as reservoirs. Infection rates are highest (49 percent dogs, 45 percent cats) in immature animals, particularly strays, and lowest in adult animals living in households (33).

Discussion

Among the most common of the enteric bacterial infections of humans throughout the world, campylobacteriosis causes both diarrheal and systemic illnesses. The universal prevalence of campylobacteriosis is of major importance because the association of *Campylobacter* spp. with human enteric illnesses was observed only recently.

Campylobacter spp. are present in the environment and in warm-blooded animals throughout the world. In most infected animals, it remains in a lifelong carrier state and the animal develops specific immunity.

The vast reservoir in animals is probably the source of infection for most humans who consume food or water which has been polluted by animals who harbor campylobacters in their feces (8,18).

Recently, the organism has been identified as a leading cause of acute bacterial gastroenteritis in the United States (8). Fecal excrement from apparently healthy, wild and domestic animals is likely the major source of *C. jejuni* and the primary vehicle for transmitting the organism to food.

The ultimate objectives in dealing with foodborne pathogens of public health concern are control and prevention. Several factors must be considered. It is quite obvious that multiple research endeavors must be undertaken before answers to questions involving this complex pathogen, its behavior, pathogenicity, epidemiology, and prevention will become a reality.

Most cases of *Campylobacter* enteritis are sporadic, and it is often difficult to confirm their source and to estimate the magnitude of the problem and its cost. One study estimated a mean duration of 13.52 days for *C. jejuni* illness, with approximately half of that time lost to normal activity such as employment (31).

If current estimates are correct, *Campylobacter* enteritis occurs at least twice as frequently as salmonellosis. The Centers for Disease Control estimates the occurrence of approximately 2 million cases of salmonellosis annually in the United States, at a cost that exceeds $1 billion.

The cost of *C. jejuni* enteritis, therefore, can be expected to exceed $2 billion annually (31).

These estimates obviously are crude and are subject to criticism, but most of the data related to foodborne diseases are imperfect and can only be extrapolated. Regardless of shortcomings in cost accounting, it should be appreciated that *C. jejuni* has serious economic impact and public health significance.

Because campylobacteriosis is a chronic public health problem, it poses a challenge to health authorities at all levels of government, industry and the scientific/academic community.

Conclusion

In retrospect, it is doubtful that the total absence of pathogenic organisms ever can be achieved. The web of causation of campylobacteriosis is so diverse that complete elimination of *Campylobacters* from domestic animals is not feasible at this time.

Programs to reduce the incidence should be carried out on a global scale and administered by government agencies with oversight of the agricultural and food industries and the general public.

The production of foods of animal origin should incorporate procedures to either produce a *Campylobacter*-free product or to minimize the incidence of contamination.

Important basics for prevention and control on the human side include good food handling practices in homes, institutions and public eating establishments. These can be realized by adequate refrigeration, good personal hygiene, proper heating to prevent microbial replication, and proper processing practices to eliminate contaminants.

The *Campylobacter* problem must be thoroughly defined. Adaptation of prescribed control principles must have national and international vistas if any progress is to be anticipated. Coordination and cooperation among a broad range of interest groups must be brought under a single umbrella to make objective the mission for control and prevention. ◆

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The following comments are excerpted from a speech presented by Dr. Lester M. Crawford, Administrator of the Food Safety and Inspection Service, U.S. Department of Agriculture, before a committee of the National Broiler Council, Hilton Head Island, S.C., June 10, 1991. Copies of the complete speech, "Food Safety is Everyone's Job," may be requested by using the order form on the back of the magazine.

"I know many of you feel, as we do, that we are at a time of reckoning on this issue. Our 800 number hotline calls about poultry safety reinforce this point. They have increased by 50 percent over last year at this same time. I think it is safe to say most of the calls resulted from the news media coverage of the issue.

"The stories contain some facts and many fallacies. However, whether the information in the articles is factual or manufactured does not matter at this point. What does matter is the public perception of the situation—public confidence in poultry products is indeed shaken. If you don't see the effects in your pocketbook today, you probably will tomorrow.

"I believe it is incumbent upon you, the industry, to deal quickly and aggressively with each facet of the crisis now facing your poultry industry. We cannot do it for you.

"All aspects of the poultry industry—from poultry farmer to processor to market—must be equally committed to ensuring the safety of the poultry supply. This means stepped up efforts to integrate the Hazard Analysis and Critical Control Point (HACCP) system into poultry production from farm to retailer. You need to do more than implement HACCP-like systems yourselves. You need to take an active role in encouraging HACCP in the hatchery and grow-out phases or requiring it if you have an integrated system. You also need to get on board FDA's salmonella control program.

"Other recommendations I urge you to seriously consider are:

1. Open your doors!
People fantasize about what happens in a poultry plant. Don't give your opponents the opportunity to use these empty fantasies as live ammunition against you....set up a dialogue with the public-at-large. Why not open your plant up to public tours? Give consumers a "bird's eye view" of how a modern, clean poultry plant operates. What the public doesn't know has hurt the industry.

2. Move forward on nutrition labeling.
If the poultry industry enthusiastically accepts and pushes nutrition labeling, you'll gain in consumer confidence because nutrition labeling is what consumers want.

3. Put handling instructions on your labels.
The National Advisory Committee on Microbiological Criteria for Foods not only endorses this idea, but also encourages such action! The reason is simple: Queries on our meat and poultry hotline show that people know less today than our parents did about the proper care and preparation of poultry. Care labeling is not the same as a warning label. It is a recognition that current generations need to know that care is needed in the kitchen as well as in poultry processing plants.

4. Don't expect USDA to take the heat for you.
The job of FSIS is to protect the public health, and that we will do at all costs. As you know full well, if it comes to choosing between the health of agribusiness and the health of the American people, we will take the public health course every time.

5. Recognize that if some changes aren't made voluntarily they will be imposed on the industry.
USDA does not now have the authority or the scientific rationale to impose microbiological criteria on raw meat and poultry products. However, Congress, fed by misinformed public perceptions and pressured by misleading, so-called consumer activists, may direct us to do so. The window of opportunity is still open for the industry to make changes, but it may close quickly.

The time has come to think creatively, to draw out the best suggestions you can from your colleagues and your workforce. Next, quickly evaluate the options, make choices, and do something that shows you are listening to the American consumer."

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Universities Target FSIS Research Needs

by Jacque Lee, Editor,
FSIS Food Safety Review

Scientists at the University of Arkansas, Iowa State University and Kansas State University have teamed up to conduct food safety research.

"The Food Safety Consortium is already producing promising results that can soon be put on-line in processing plants and by our food inspectors," says Dr. William Dubbert, Associate Deputy Administrator of the Food Safety and Inspection Service's Science and Technology Division. Dubbert has been active on the organizing committee for the Consortium, which was established through a USDA Cooperative State Research (CSRS) special grant, approved by Congress in 1988.

"The focus of the Consortium is meat and meat product safety, from the farm to the consumer's table," says Dr. Dubbert.

Dr. Dubbert notes that as a regulatory agency FSIS has a direct role in research for food safety.

"The right hand has to know what the left hand is doing, and with the Consortium, we can tell them what our needs are. They can tell us what they are doing and also ask us what we need to have done. It is a natural relationship, and it is natural that we talk and talk regularly," adds Dr. Dubbert.

Jacque Lee is a Senior Public Affairs Specialist in the Food Safety and Inspection Service Information Office in Washington, D. C.

"...the shorter we can make the journey from results to peer review to implementation– the better." — Dr. Dubbert

The FSIS official calls the avoidance of duplication a particular benefit in the Consortium approach to research.

"Communication within the Consortium can save time and money, and that is important in today's research world," Dr. Dubbert says. "We have many needs in the arena of food safety research, and the shorter we can make the journey from results to peer review to implementation—the better."

Each of the three member institutes has selected an area of primary research. The University of Arkansas is concentrating on poultry, Iowa State University on pork, and Kansas State on beef.

Coordinated research projects among the universities are being conducted on prevention, detection and removal or inactivation of pathogenic microorganisms. Other projects focus on chemical, drug and microbial toxin residues in poultry, pork and beef.

Other research includes epidemiological studies at production levels, biotechnological assays and treatments at processing levels, Hazard Analysis and Critical Control Point (HACCP) studies at processing

University of Arkansas food science professor Dr. Michael Johnson (right) is assisted on his research project to develop a monoclonal antibody method of Listeria monocytogenes *detection by research assistant Pete Ball (left) and Dr. Arun Bhunia, a post doctoral research assistant. Bhunia is examining a culture plate with colonies of the food-borne bacterial pathogen. Johnson is holding a "fingerprint" of proteins from the surface of* Listeria monocytogenes *cells.*

and handling levels, and risk assessment and cost/benefit measurements on preventive and interdictive measures.

In all, 38 projects are being conducted in four major areas: rapid identification of infectious agents and toxins, evaluation of potential health risks posed by product contamination, determination of the most effective intervention points to control microbiological or chemical hazards, and development of techniques to effectively monitor meat and poultry processing and distribution.

Having research conducted under one "roof" in three different institutions and states is made possible through the Consortium's Steering Committee and Technical Review Committee. The Technical Review Committee is responsible for coordination and evaluation of the research. This committee is composed of two research scientists from each institution plus the Assistant Deputy Administrator for Scientific Staff Services, FSIS, and the USDA- CSRS project coordinator who serve as *ex officio* members.

The Technical Review Committee reports once yearly to the Steering Committee, which oversees the program to ensure that everything is progressing satisfactorily to meet goals mandated by Congress. Administrators from the institutions serve on this committee, along with representatives from the beef, pork and poultry industries.

The Consortium holds a general meeting each fall. Principal investigators and their staffs present updated progress reports and exchange ideas and information.

A major goal for years four and five of the Consortium is technology transfer to processors in the food industry. However, some projects from the Consortium may soon prove beneficial to industry. One is Dr. Daniel Fung's "U" tube, being developed at Kansas State in conjunction with University of Arkansas' Dr. Michael Johnson's Deoxyribo-nucleic acid (DNA) probe for faster detection of *Listeria monocytogenes.*

Results from another project that may be used soon by industry involves chill water in poultry processing. Recent studies at the University of Arkansas have shown that treating overflow chill water with ozone in processing plants meets current USDA reuse standards. Reusing this water—normally added to municipal sewer systems—would greatly benefit local environments and save processors the expense of cooling tap water to 4°C.

To obtain a directory of Consortium personnel and further information about current work, contact Michael Shirkey, 110 Agricultural Building, University of Arkansas, Fayetteville, Ark. 72701; or phone 501-575-6940. ◆

Tube Speeds Listeria Detection

A recent development by Food Safety Consortium researchers at Kansas State University is already simplifying and accelerating the detection of *Listeria monocytogenes* and other *Listeria* species in mixed cultures of meat products.

Such an advance will be good news to government regulators, the food industry, and food hygienists who daily see the need for rapid detection and enumeration of *Listeria* to facilitate "ship-no ship" decisions, perform regulatory screening, and monitor processing hygiene. The new process would also assist Food Safety and Inspection Service inspectors who would verify control procedures under the planned Hazard Analysis and Critical Control Point (HACCP) system.

Dr. Daniel Y. C. Fung, a professor in the Department of Animal Sciences and Industry at Kansas State University and a member of the team of scientists funded through the Food Safety Consortium, and his graduate student, Linda Yu, have developed a simple and rapid method of *Listeria* detection.

Dr. Fung's method depends on a motility enrichment system, similar to one which has been used successfully for the rapid isolation of *Salmonella*. The *Salmonella* system has been commercialized as the BioControl 1-2-*Salmonella* Test.

Using the same basic idea, Dr. Fung's laboratory began testing liquid enrichment and solid plating techniques in various combinations to attempt to find a combination that would precisely identify *Listeria* in the shortest possible time.

As a result of work begun in the fall of 1989, the laboratory determined that the most suitable combination for the identification of *Listeria* was Fraser enrichment broth combined with Modified Oxford agar for motility enrichment. The rapid detection procedure requires a commercially available "U"-shaped culture tube.

The culture tube is basically two test tubes connected at the bottom by a capillary tube.

The Fraser broth is placed in the left and right arms of the tube and the semi-solid Modified Oxford agar is placed in the "U" or bottom part of the tube. The *Listeria* are placed in primary enrichment in Fraser broth and held at 30° C for 24 hours. then 1 ml of the enrichment broth is placed in the Fraser broth in the left arm of the "U" tube.

The Fraser broth selectively isolates and promotes *Listeria* growth and precludes the growth of non-motile organisms. The microbes migrate through the Modified Oxford agar and arrive as a pure culture in the second branch of Fraser broth. This becomes the second enrichment necessary for the identification of *Listeria*.

When the *Listeria* arrive at the right arm of the "U" tube, the Fraser broth becomes turbid and eventually a black precipitate is formed.

An even earlier indication that *Listeria* are present is the formation of a black precipitate as the bacteria move through the Modified Oxford agar. At the time turbidity develops, a sample can be taken for DNA probe analysis to confirm the presence of *Listeria*.

Dr. Fung determined that the secondary enrichment step using the "U" tube reached its endpoint (development of turbidity) in the second arm in as little as 12 hours. Even at this rate, the presumptive identification of *Listeria* took less than 24 hours and was sensitive to bacterial levels as low as 10^2-10^4.

Fung's approach differs from current USDA and FDA regulatory methods that may require nine to 14 days for positive identification.

Dr. Fung has looked for ways to continue to improve his "U" tube system. He found in his work with the *Listeria* "U" tube that *Listeria* migrated through the "U" tube faster in the presence of *E. coli* than in its absence.

Consequently, the Kansas State researcher became interested in the characteristics of Oxyrase@ because the enzyme is an *E. coli* membrane enzyme. Oxyrase@ was added to the Fraser broth both in the primary enrichment step and to the arms of the "U" tube to create a more microanaerobic environment that *Listeria* favors.

The result was an enhancement of the growth rate of the *Listeria* in the broth, accelerated movement through the Modified Oxford agar, and an even earlier appearance in the second branch of the tube.

Dr. Fung tested the system both with pure cultures of *Listeria* and in the presence of competitive organisms in enriched samples of ground beef. Presumptive identification of *Listeria* was achieved with very low numbers of L. monocytogenes (1-100 CFU/g) within 10 hours.

Listeria were isolated in pure culture from mixed cultures that included *Klebsiella, Proteus, Salmonella, Shigella, Staphylococcus,* and *Streptococcus.*

As a result of Fung's findings, Kansas State University has applied for a patent on the process. Several firms have expressed interest in developing test kits for commercial use.

Dr. Fung continues to apply the "U" Tube system with Oxyrase@ to other motile, facultative anaerobes with success. He and graduate student Linda Yu planned to publish the results of their work with *Listeria* in June 1991. ◆

Study Shows Nitrosamines In Elastic Netted Hams

by Carl Custer, FSIS

Summary: In 1990, the Food Safety and Inspection Service (FSIS) conducted a limited study to determine the source of high levels of N-Nitrosodibutylamine in cured cooked hams processed in a commercial establishment. Results showed that elastic netting, manufactured with rubber threads, caused nitrosamine formation at levels up to 50 parts per billion (ppb) in the outer layer (3/16 inch) of the hams. These results substantiate previously published data showing that rubber compounded with certain vulcanizing accelerators should not be permitted to contact nitrite-containing food products.

In April 1990, the USDA Food Safety and Inspection Service (FSIS) evaluated a new processing procedure being used in two establishments, named as Establishment 1 and Establishment 2 in this article.

Analytical results from cross-sections of hams from Establishment 1 exhibited levels of N-Nitrosodibutylamine (NDBA) up to 23 parts per billion (ppb). Ham samples from Establishment 2 had no detectable nitrosamines.

Carl Custer is a staff officer with the Processed Products Inspection Division of USDA's Food Safety and Inspection Service. He earned both a B.S. in Microbiology and an M.S. in Food Technology from Texas A&M University.

One major processing difference between the two establishments was that Establishment 1 cooked its hams in elastic netting; Establishment 2 did not. These results were consistent with earlier scientific research (1, 5, 6, 8) showing that rubber compounds contacting nitrite-cured meat products could produce high levels of NDBA.

Earlier research showed that rubber processed using certain dithiocarbamates as vulcanizing accelerators (6, 8) contained nitrosatable amines that react with nitrite to form volatile nitrosamines. The nitrosamines associated with rubber are primarily NDBA and N-Nitrosodiethyamine (NDEA). Some nitrosamines, including NDBA, are carcinogenic in laboratory animals and may be carcinogenic in humans.

The Food and Drug Administration estimates that consumption of nitrosamines at the average levels in hams processed in the netting poses a potential life-time risk of about four in one million, and a short-term risk of about three in one billion. The "risk" represents an estimation of the likelihood that someone will develop cancer.

Therefore, to develop additional information, FSIS designed a study to confirm whether or not it was the nettings that caused the high NDBA levels in hams.

The experimental design was simple: boneless hams from the same batch were prepared with and without netting. The sole difference between the experimental hams and the controls was the presence or absence of elastic netting. Establishment 1 volunteered to conduct the ham processing part of the experiment in its plant.

Methods Used

Ham Processing: Twelve hams for this study were selected from a regular production tumbler batch of boneless hams. The establishment processed the hams by pumping 12-to-14 pound boneless hams to 132 percent of the original weight with a solution of brine and curing ingredients.

The establishment then allowed the excess brine to drain back to 127 percent of the original weight. This is a commonly practiced procedure in many establishments for appropriately labeled products. The drained hams were then trimmed of gristle and some fat, placed in a vacuum tumbler along with additional water and flavoring ingredients, and then slowly tumbled for four hours.

The final product contained, in order of predominance: fresh ham, water, salt, sugars, sodium phosphate, autolysed yeast, hydrolyzed plant protein, sodium erythorbate, and 200 parts per million of sodium nitrite [which complies with 9 CFR 318.7 (c)(4) defining limits for added substances] (3). Twelve hams were selected from the tumbler for this study.

Variables: The three treatments were: 1.) four hams were stuffed into netting only, 2.) four were stuffed into collagen film then into netting, and 3.) four were stuffed into fibrous casing only (controls). The establishment's normal practice is the second procedure.

Materials: The netting was "Zip Net" manufactured by C&K Manufacturing and Sales Co. The collagen film was "Collagen Food Film," manufactured by Brechteen Co. The fibrous casing was "12 X 24 Fibrous," supplied by Viskase Corp. (3).

Cooking: The 12 experimental hams were placed on the same cooking tree, each treatment on one of three different levels. Cooking was done in a standard smokehouse, along with a normal batch of netted hams. Final internal temperature was 148°F.

Shipping: After cooking, the establishment brine-chilled the product to 45-50°F within four-and-a half and five hours and then packaged it. FSIS inspection personnel continued cooling the samples overnight and shipped them to the FSIS Eastern laboratory in shipping containers containing additional refrigerant (4).

FSIS Control: Through use of an official retain tag and personal observation, FSIS inspection personnel had direct control of the product from the time the hams were stuffed.

Sample Preparation: FSIS chemists removed the netting from the netted samples. Fibrous casings were removed; collagen films were not. From all samples, the chemists sliced an approximately $^{3}/_{16}$ inch thick slice from the outer surface of each ham sample.

The chemists then prepared a portion of each slice by either frying or not frying. Samples for frying were fried in a 325°F preheated electric skillet for three minutes on each side.

Additional preparation of the fried and non-fried samples was conducted according to FSIS Chemistry method 5.020, revised June 1987 (2).

Nitrosamine Analysis: Sample extracts were analyzed by the mineral oil distillation method (MOD) using thermal energy analyzer detection. Sample extracts to be confirmed by mass spectrometry were prepared by the low temperature vacuum distillation method (LTD). All analyses conformed with FSIS Chemistry method 5.020, revised June 1987 (2).

An FSIS employee takes the internal temperatures of hams analyzed in the FSIS nitrosamine study.

Results

The nitrosamine results are summarized in Table 1. The results are similar to the surface sample values published by Sen (5, 6). The results show uniformly high NDBA results on the hams with netting, and lower NDBA results on the control hams without netting.

These results clearly show a link between the presence of netting and high NDBA levels in the hams' outer surfaces.

FSIS theorizes the source of NDBA on the control hams was contributed by: A. contamination from the netted hams by direct contact or by their drippage (they were all cooked on the same smokehouse tree), or B. absorption of butylamine or NDBA volatilized from netted hams during cooking. (All hams were processed in the same smokehouse; all hams were netted except the four control hams.)

The second most common nitrosamine identified from the netted hams was nitrosopiperidine (NPIP). This nitrosamine had been previously associated with rubber compounds (7). Although the NPIP levels were low, only netted hams contained NPIP.

Mass spectrometric analysis confirmed the presence of NDBA in five samples prepared by the low temperature vacuum distillation method. Table 1 identifies those samples.

The effect of frying the ham samples in preparation for nitrosamine analysis was also investigated. Out of the eight netted hams, six yielded higher NDBA values when fried than did the non-fried preparations.

However, the average difference was small, less than 10 percent of the average NDBA value. Based on parametric and nonparametric statistical analyses, the statistical significance of the difference was not great, P 0.35.

Conclusion

The results in Table 1 alone strongly indicate that elastic netting contributed to the high NDBA values in netted hams. The results are consistent with previous research, the chemistry of nitrosamine formation, and the chemistry of rubber.

Therefore, these results substantiate previous research that certain compounds in rubber (nettings) should not contact nitrite cured food products because they may result in high levels of nitrosamine being formed on the surface of the product. ◆

TABLE 1
Nitrosamine Levels In Cooked Cured Hams Processed With Or Without Elastic Netting

Sample Type	Fried / Not Fried	Results (ppb) NDBA	NDMA	NPIP	FSIS Sample #	Internal Lab #
Net Only B1	Not Fried	43.3	1.6	1.9	11518	RO51532
Net Only B1	Not Fried	46.3	(LTD)	*	"	RO51532
Net Only B1	Fried	45.9	-**	2.9	"	RO51531
Net Only B2	Not Fried	22.8	-	0.9	11517	RO51550
Net Only B2	Fried	45.5	-	1.3	"	RO51549
Net Only B3	Not Fried	44.1	1.4	2.1	11509	RO51544
Net Only B3	Not Fried	42.0	(LTD)		"	RO51544
Net Only B3	Fried	36.4	2.6	-	"	RO51543
Net Only B4	Not Fried	28.4	0.9	-	11508	RO51554
Net Only B4	Fried	31.2	2.1	1.9	"	RO51553
Avg: 37.2 (less LTD)RO51555						
Net & Col A1	Not Fried	39.1	3.3	0.8	11516	RO51556
Net & Col A1	Fried	39.9	4.2	-	"	RO51555
Net & Col A2	Not Fried	45.6	-	-	11515	RO51540
Net & Col A2	Not Fried	44.1	(LTD)		"	RO51540
Net & Col A2	Fried	42.9	-	-	"	RO51539
Net & Col A3	NotFried	46.4	-	-	11502	RO51542
Net & Col A3	Fried	46.8	-	-	"	RO51541
Net & Col A4	Not Fried	43.3	1.2	-	11501	RO51534
Net & Col A4	Not Fried	40.4	(LTD)		"	RO51534
Net & Col A4	Fried	50.0	1.1	-	"	RO51533
Avg: 44.25 (less LTD)						
Case Only C1	Not Fried	13.8	1.0	-	11507	RO51538
Case Only C1	Fried	6.8	-	-	"	RO51537
Case Only C2	Not Fried	4.8	-	-	11506	RO51536
Case Only C2	Fried	4.8	-	-	"	RO51535
Case Only C3	Not Fried	14.9	4.7	-	11505	RO51536
Case Only C3	Fried	10.4	0.9	-	"	RO51535
Case Only C4	Not Fried	19.2	-	-	11504	RO51546
Case Only C4	Not Fried	13.1	(LTD)		"	RO51546
Case Only C4	Fried	8.6	-	-	"	RO51545
Avg: 10.4 (less LTD)						

** LTD = Low temperature vacuum distillation*
*** None detected*

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NDBA Levels Detected in Hams

Summary: To follow up on an earlier, April 1990 study, FSIS in the fall of 1990 collected from retail stores nine hams that had been processed with elastic netting in a federally inspected establishment. Another five hams were collected that had no netting or were processed in non-elastic netting. All 14 hams were analyzed for nitrosamine content. Dibutylnitrosamine (NDBA), a nitrosamine associated with rubber, was confirmed in seven of the nine elastic netted hams; nitrosopiperidine (NPIP)was found in a surface portion of one of these seven. NDBA levels in cross-section slices ranged from 1 to 19 parts per billion (ppb); surface slices ranged from 15 ppb to 123 ppb NDBA and one surface slice contained 2 ppb NPIP. None of the five hams processed without elastic netting had detectable nitrosamines.

Purpose

FSIS carried out this limited study to see if the industry had resolved the problem of nitrosamine contamination of meat processed in elastic netting. Regulatory action was not planned because high levels of nitrosamines were not expected.

In addition, the absence of planned regulatory action permitted more flexibility in the sampling and analytical procedures, e.g., surface sampling.

Sample Collection: FSIS compliance officers selected samples in retail stores based on a September 1990, FSIS survey of elastic netting use in ham processing establishments. Laboratory workers purchased two hams with no sign of net usage at a local retail market for use as control samples.

Sample Preparation: FSIS analysts removed any netting remaining on the samples and selected both a cross section portion and a surface portion for separate analysis. Each cross section portion was an inch slice from the ham's midsection; each surface portion was an inch-thick slice from the outer surface of each ham sample.

Additional preparation of the samples was consistent with FSIS Chemistry Laboratory Guidebook Method 5.020, revised June 1987, with the exception that no further cooking or frying was done to the selected portions.

Nitrosamine Analysis: Sample extracts were prepared by the low- temperature vacuum distillation method (LTD), then analyzed using thermal energy analyzer detection. The FSIS nitrosamine method detects and identifies any of seven nitrosamines; they are:

NDBA,
NPIP,
N-nitrosodimethylamine,
N-nitrosodiethylamine,
N-nitrosodipropylamine,
N-nitrosopyrrolidine, and
N-nitrosomorpholine.

Samples containing >5 ppb nitrosamine were confirmed using mass spectrometry. All analyses were performed according to FSIS Chemistry Laboratory Guidebook Method 5.020, revised June 1987. Repeat analyses on three samples served as quality control checks.

The study had been planned to analyze 12 hams processed in elastic netting and two hams not actually processed in elastic netting (as controls). However, laboratory examination showed that the netting on two of the 12 hams was non-elastic, and FSIS Inspection Operations confirmed that another ham had been processed in non-elastic netting. Thus, the study consists of 14 hams, nine hams processed with elastic netting and five control hams.

Only NDBA and NPIP were detected, as Table 1 indicates. Both of these nitrosamines have been associated with rubber compounds. None of the five other nitrosamines detectable by the FSIS method were detected.

Seven of the nine hams processed in elastic netting had detectable nitrosamines on the surface. The cross section portions of 3 hams contained over 10 ppb NDBA, another 3 hams contained >5 ppb NDBA, and 1 yielded 1 ppb. Only two elastic net processed hams had no detectable nitrosamines. None of the hams processed without elastic netting had detectable nitrosamines. Mass spectrometry confirmed all nitrosamine results above 5 ppb as NDBA.

ARS Studies Elastic Nettings

FSIS has contracted with the Agricultural Research Service (ARS) to conduct a research project, entitled "Nitrosamine Formation In Cured Meat Products With Elastic Rubber Netting." The project will seek to find how nitrosamines form in cured meat products during processing. It will also focus on the influence of approved and newly petitioned additives so that methods can be developed to reduce or eliminate nitrosamines in cured meat products. ARS researcher Walt Fiddler will conduct the study at the Eastern Regional Research Center in Philadelphia, Pa.

Repeat analyses on three samples were performed 6 to 12 days after the original analyses. These results show good repeatability considering that NDBA is highly volatile and not as repeatable as other, less volatile, nitrosamines.

Five hams, all from separate establishments, had netting marks, but no netting. Inspection Operations (IO) confirmed that one of these hams is currently processed with a non-elastic netting but the other four are processed in elastic netting. NDBA levels on the surface of these hams without netting ranged from the lowest (not detected) to the highest (123 ppb).

Netting manufacturers were not determined because these were retail samples, and establishments are not required to record which netting manufacturer's product is used on a production lot.

In 1990, FSIS had confirmed the presence of high levels of NDBA on the surface of hams from one establishment. Two of the retail samples collected in this study were processed by this establishment, one with elastic netting present and one with non-elastic netting present. Neither had any detectable nitrosamines.

Because NDBA is primarily a surface contaminant, the cross section NDBA levels should decrease as the cross section areas increase. The results of this study were consistent with that inverse relationship. A comparison of the hams' cross section areas with their ratios of cross section NDBA to surface NDBA showed a high correlation (-0.83). Thus, the larger the ham cross section area, the lower the cross section DBNA level; this results in a greater underestimation of consumer exposure because other surfaces, such as end pieces, are eaten.

The results of this study and portions of these samples are being sent to the Agricultural Research Service, Eastern Regional Research Center, for their research on migration of nitrosamines and their precursors into hams.

Conclusion

These data show that high levels of nitrosamines are present in some retail hams manufactured under federal inspection. Seven of nine hams processed with elastic netting had detectable nitrosamines; three of these had cross section NDBA levels greater than 10 ppb.

None of five hams processed without elastic netting had detectable nitrosamines. Since FSIS has no comparative data, it is not known if these nitrosamine levels or incidence are changed from the 1990 study.

Nevertheless, these results support the earlier FSIS position that elastic netting can contribute to unnecessary nitrosamine formation in inspected products.◆

TABLE 1

Study Of Nitrosamines In Retail Hams With Netting
Results and Discussion

NITROSAMINE RESULTS (in ppb)				SAMPLE INFORMATION			
NDBA		NPIP			NETTING		
Cross Sec.	Surface	Cross Sec.	Surface	Sample No.	Present?	Elastic?	Date analyzed
19	51			869639	YES	YES	1/09/91
13	83			398184B	YES	YES	1/23/91
12	68			398184A	YES	YES	1/17/91
11	114	ND	2	436414B	NO	YES	1/23/91
9	60			449108A	YES	YES	1/11/91
8	123	ND	2	436414A	NO	YES	1/17/91
8	24			803907	NO	YES	1/17/91
7	57			449108B	YES	YES	1/23/91
5	18			126409	YES	YES	1/09/91
1	15			475831	NO	YES	1/09/91
ND	ND			398182	YES	YES	1/15/91
ND	ND			263110	NO	YES	1/15/91
ND	ND			41168	NO	NO	1/15/91
ND	ND			398183	YES	NO	1/11/91
ND	ND			966197	YES	NO	1/11/91
ND	ND			803698	NO	NO	1/22/91
ND	ND			803699	NO	NO	1/22/91

ND = Not detected Samples with a B suffix are duplicates of those with an A suffix.

New Residue Test Is FASTer

After three years of extensive laboratory testing, the Food Safety and Inspection Service plans to field test a new procedure that reveals violative antibiotic residues in food animals within five hours.

Funds have been approved to start trials in meat plants for the Fast Antibiotic Screen Test (FAST). Results will determine how the new method compares with the currently used STOP (Swab Test On Premises) and CAST (Calf Antibiotic Sulfa Test) for sulfonamides, tetracycline, and other antimicrobial residues. Both current tests take overnight to produce results.

Tentative plans call for FAST field tests to start in five California meat plants before September.

If the FAST field tests prove successful, FSIS meat inspectors could know the results of samples taken from animal tissues within the time frame of a single work shift in a plant. Carcasses that do not show residue could be released on the same day the FAST test is conducted. Carcasses that test positive for residue would be retained, or condemned, just as they currently are.

FSIS microbiologists in Beltsville, Md., developed the FAST test, based on recommendations of Bernard Schwab, chief of the FSIS Medical Microbiology Branch. He had read of the basic technique in a German scientific paper and suggested the possible basis for a new rapid residue test.

The FAST petri plate contains an agar growth medium in which there is sugar and a purple dye. To perform the test, the agar surface is streaked with the spores of the test bacteria and placed in an incubator at 45° C for one hour to enhance bacterial growth.

Next, a sterile cotton swab saturated with fluid from a tissue sample is placed onto the FAST plate surface, and the plate is placed in the incubator for an additional four hours. The growing bacteria convert the sugar to acid, changing the color of the purple dye to yellow.

If a purple zone remains around the sample swab, and the rest of the plate turns yellow, indicating bacterial growth, the test results are positive.

"The antibiotic in the sample swab diffuses into the agar and prevents bacterial growth," says FSIS microbiologist Susan Bright, the project leader for the FAST tests in Beltsville. "This area, called the zone of inhibition, remains purple. The area where antibiotics are absent turns yellow." Bright explains.

If the entire plate turns yellow, and no purple zone forms around the cotton swab, tests results are negative. There is no antibiotic present to inhibit bacterial growth and the color change associated with it.

"While the test is simple to perform, it took three years and many experimental steps, using numerous combinations of reagents, to reach this stage," said Nitin Thaker, the supervisory microbiologist for the FSIS project.◆

The Scientist as Explorer

— from "Noted With Pleasure," New York Times Book Review, 1991

The physicist Heinz R. Pagels, who died in 1988, believed that any quest for the absolute only gets in the way of good science. This is from his *Perfect Symmetry: The Search for the Beginning of Time* (Bantam Paper).

"Maybe there is some final truth to the universe—I do not know. Yet suspending such beliefs opens us to new ways of exploring. Later we can compare our new knowledge and beliefs with the old ones. Often such comparisons involve contradictions; but these, in turn, generate new creative insights about the order of reality. The capacity to tolerate complexity and welcome contradiction, not the need for simplicity and certainty, is the attribute of an explorer. Centuries ago, when some people began instead to ask how things worked, modern science was born. Curiously, it was by abandoning the search for absolute truth that science began to make progress, opening the material universe to human exploration. It was only by being provisional and open to change, even radical change, that scientific knowledge began to evolve. And, ironically, its vulnerability to change is the source of its strength."

Articles by FSIS Scientists

The following articles by Food Safety and Inspection Service staff have appeared in recent publications:

"Evaluation of Colorimetric DNA Hybridization Test for Detection of Salmonellae in Meat and Poultry Products," *Journal of Food Protection*, February 1991, Vol. 54: 127-13. Bonnie E. Rose, Carlos M. Llabres, and Barbara Bennett, FSIS, USDA Bldg. 332, BARC, Beltsville, Md., 20705.

"Application of Acute Phase Reactants During Antemortem and Postmortem Meat Inspection," *Journal of the American Medical Association,* June 1, 1991, Vol. 198, No. 11, 1898-1901. Parmesh K. Saini, BVSc & AJH, PhD, and Donald W. Webert, DVM, MS(Med), FSIS, USDA Bldg.318-C, BARC-East, Beltsville, Md., 20705.

"Accumulation of 2,8 Dihydroxyadenine in Bovine Liver, Kidneys and Lymph Nodes," *Veterinary Pathology,* 1991, Vol. 28:99-109. P. C. Mc Caskey, FSIS, Beltsville, Md. and L. Friedlander, FSIS, Wyaluslng, Pa., with W. E. Rigsby and D. M. Hinton, Agricultural Research Center, Athens, Ga., and V. J. Hurst, Department of Geology, University of Georgia, Athens, Ga.

"Salmonellosis Prevention," *Journal of Environmental Health,* March/April 1991, Vol. 53:No. 5, 34-36. Don A. Franco, FSIS Slaughter Operations Staff, Inspection Operations, Washington, D.C. 20250.

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Introducing the Editors of *Food Safety Review*

Jacque Lee

Food Safety Review Editor Jacque Lee is a graduate of the University of Nebraska School of Journalism and has been a reporter for newspapers, radio, and television.

Lee is a former bureau chief for The Miami Herald, was a newscaster for WTVJ(CBS) in Miami, Fla., and for eight years served as press secretary for former Rep. Virginia Smith, R-Neb., then vice chairman of the House Appropriations Subcommittee on Rural Development, Agriculture and Related Agencies.

Before joining the Food Safety and Inspection Service Information Office in September 1990, Lee was a Public Affairs Specialist with the Agricultural Marketing Service.

Dale Blumenthal

Food Safety Review Associate Editor Dale Blumenthal has a masters degree in health communications from the University of Maryland. She has covered science and health topics for news publications, magazines, and audiovisual productions for more than 10 years, and since 1986 has specialized in food and drug issues.

Before joining the FSIS Information Office in June 1991, Blumenthal was a writer in the Food and Drug Administration's publications office.

Don A. Franco

FSR Contributing Editor Dr. Don Franco, DVM, serves as an adjunct assistant professor of medicine at the George Washington University Graduate School in Washington, D.C. and at the same time is the Director of Slaughter Operations for the Food Safety and Inspection Service. He has served as an adjunct professor at the Tuskegee University College of Veterinary Medicine, in Tuskegee, Ala. and at Emory University in Atlanta, Ga.

A native of Trinidad, Dr. Franco received a Cambridge School Certificate from St. Mary's College in Port-of-Spain prior to earning a diploma in agriculture from the University of Guelph in Ontario, Canada, in 1957. He earned his Doctorate of Veterinary Medicine degree with a specialty in tropical animals from the University of the Philippines in 1964, a Master of Public Health degree from Emory University School of Medicine in 1985, and a Board Certificate from the American College of Preventive Medicine in 1982.

Dr. Franco was in private veterinary practice before joining the U. S. Department of Agriculture in 1968. He has published numerous articles in scientific journals and is the author of the book, "Selected Pathology of Food Producing Animals."

Robert E. Burke, Jr.

Robert E. Burke, Jr. is the editor of technical and nontechnical material produced by the Food Safety and Inspection Service's Program Training Division in Denton, Texas. The material is used by meat and poultry inspectors nationwide.

Burke also is the editor of the newsletter for the American Association of Food Hygiene Veterinarians, a publication devoted to reporting developments in the scientific and regulatory areas of food hygiene.

Before joining FSIS in 1976, Burke was with the Consumer Product Safety Commission and the Food and Drug Administration.

Burke is a Phi Beta Kappa graduate of the University of Maryland and has attended Creighton University, Loyola University, and Omaha University (now the University of Nebraska at Omaha).◆

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- ❑ A Margin of Safety: The HACCP Approach to Food Safety Education—Project Report, July 1989.

Background Materials

- ❑ Strategy for Food Labeling Reform: FSIS Response to the National Academy of Sciences' 1990 Report, "Nutrition Labeling: Issues and Directions for the 1990's."
- ❑ Nutrition Labeling of Meat and Poultry: Backgrounder
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- ❑ Clenbuterol: Backgrounder
- ❑ Campylobacter Questions and Answers
- ❑ "Food Safety Is Everybody's Job," Speech by Dr. Lester M. Crawford, FSIS, National Broiler Council, June 1991.

Brochures and Pamphlets

- ❑ Meat & Poultry Safety: Questions and Answers About Chemical Residues, FSIS-38, September 1990.
- ❑ People, the Public Health, Consumer Protection, FSIS-39, September 1990 .
- ❑ Preventing Foodborne Illness: A Guide to Safe Food Handling, Home and Garden Bulletin Number 247, September, 1990.
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